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ABSTRACT

Many students face chemistry courses with a sense of fear and foreboding because it is a required course. Yet at the same time, fundamentals of chemistry have become intertwined in countless professions to say nothing of its growing importance in our everyday lives. Educators must bridge this dichotomy between attitude and importance. This paper is the case study of a systematic attempt at the U.S. Coast Guard Academy to positively change attitudes while at the same time deepening students' understanding within the discipline of chemistry. The intent of the paper is to present the framework of the Coast Guard program in order to spur others on to further efforts in exciting students with the relevance and importance of the discipline of chemistry. (Author/PR)

Promoting the Relevance & Value of Chemistry: the General Chemistry Program at the U. S. Coast Guard Academy

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Promoting the Relevance & Value of Chemistry: the General Chemistry Program at the U. S. Coast Guard Academy

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ABSTRACT

Our discipline is dying. Many of our students face chemistry courses with a sense of fear and foreboding, sitting in our classrooms because ours is a required course. Yet at the same time, fundamentals of chemistry have become intertwined in countless professions to say nothing of its growing importance in our everyday lives. Educators must bridge this dichotomy between attitude and importance. This paper is the case study of a systematic attempt at the U. S. Coast Guard Academy to positively change attitudes while at the same time deepening our student's understanding within the discipline of chemistry. The progress to date of this fledgling one year program has been worth the efforts. The intent of this paper is to present the framework of our program in order to spur others on to further efforts in exciting students with the relevance and importance of the discipline of chemistry.

INTRODUCTION

One does not have to look too far in the literature (1-3) or attend too many conferences, before being bombarded with a great deal of pessimism regarding the future of chemistry as a discipline among American college students. This pessimism emanates from a wide variety of sources. College level educators and researchers bemoan the dwindling number of students interested in pursuing the study of chemistry. Leaders from within industry recognize the approaching shortfall of graduates in the sciences, presenting their fears through dismal supply

and demand curves. Even those in positions of governmental authority have begun to promote rhetoric of doom and gloom but, like the others, they are short on viable solutions.

Unfortunately, this surge of pessimism seems to be well founded. The number and quality of students interested in math and the sciences is in fact dwindling, and chemistry is no exception (4). What is behind this persistent trend? A great number of reasons are given in the literature, and like opinions they are quite varied. Some say college level sciences are just plain dull (5). Others complain that introductory chemistry presents nothing of recognizable value to the student (6). Yet others claim that all vestiges of discovery and mental stimulation have been removed from introductory chemistry courses in favor of cramming in as much material as possible (7). Nor has the quality of instruction escaped notice! There is much to suggest that freshman courses are often overcrowded, handled by inexperienced TA's or by professors more interested in research than in dealing with a diverse blend of students. The reasons for student rejection of chemistry continue, as varied as they are diverse. You, as the teaching faculty, are in the best position to evaluate the validity of these arguments at your own institution, and if you do, you may have to conclude that some if not all are true.

So then, the experts are predicting a bleak future for the discipline of chemistry as well as science in general, and what's more they are probably right. The question that now begs an answer is obvious, what should we, the teaching faculties, do about it? There are no quick solutions! Any effective solutions are going to take a great deal of effort on the part of both educators and industry. Since the cost is going to be high, let's at least document a few reasons why we should undertake the effort. First, consider reasons of economic preservation. Perhaps, with the possible

exception of mathematics, few disciplines can claim such wide applicability across present and future American industry as does chemistry. We are simply not going to be able to compete in the ever changing market place unless our industrial sector has access to a large pool of individuals with a solid background in the chemical sciences. Second, the issues facing our society are getting ever more complex, often revolving around topics which require a base knowledge of chemistry to intelligently analyze. For instance comprehending the issues of acid rain, CO_2 and the greenhouse effect, holes in the ozone layer, and the ramifications of nuclear power, all require a foundational understanding of chemistry. Our future society will either understand the issues, or respond solely to political rhetoric and media promulgated "chemophobia.". Third, consider a purely selfish motive. What type of job satisfaction can we as educators possibly receive from facing day after day a "hostile" audience, without in some way trying to do something about it? We typically point the finger at the students and blame them. However, I am not sure that we as teachers of chemistry are always up to par. Would it not be worth it, purely from the standpoint of personal satisfaction, to take the time and effort necessary to pass on to our students some of our own enjoyment, interest and excitement in our discipline. How much more would we enjoy our jobs if we saw the spark of investigative curiosity and interest ignite? The point is this, if we grasp the long range ramifications of our efforts in the classroom, it does indeed become much easier to put in the necessary efforts to revitalize our discipline.

Thus far I have tried to establish that a problem exists, as well as a sufficient rationale to solve it. The next step is to address the specifics. What precisely can be done to change the dislike of college students toward the discipline of chemistry, and perhaps our ambivalence toward teaching as well? We have reached the purpose of this paper! Our intent is not to write another in the long series of gloom

and doom documentaries on the future of chemistry, but rather to offer some specific steps to revive the corpse. We will even go so far as to present a rough model which can be dissected and improved upon by others. However, before trying to stimulate your thinking with some specifics, we need to give you a little bit of background. We are going to be using as a point of reference the general chemistry program recently implemented at the United States Coast Guard Academy. This program is a two semester lecture/lab course taken by all first year students in support of the Academy's mission, i.e. to graduate entry level members of the officer corps who have been solidly prepared by means of a four year course of rigorous academic and professional training. We typically have 250 students broken down into eleven lecture sections and divided among six instructors. These instructors are a diverse group of civilian, military permanently stationed at the Academy, and rotating military who will teach for a four year tour of duty. As we discuss our program please keep the following items in mind:

1) We make no claim to fame for our specific program. It has been designed and implemented in most cases by a faculty with limited teaching experience, thus it has many rough edges. About the only short term claim that we can make, is that it is working. What we do hope to do is to stimulate some of our much more experienced colleagues into taking a more active role in developing and documenting their solutions to our mutual problem.

2) Already I can sense many of you tuning out because in your minds the Academy is not in any way like your institution. This, in some ways is certainly true. Yes, we do have a small population of students with very impressive high school credentials. It is also true, they were leaders in the schools from which they came, e.g. athletics, and other student activities. It just so happens that most of

them have already developed a dislike to the sciences and mathematical computations. We know this because our students tell us. They show up in our chemistry classrooms only because ours is a required course. One which they must somehow muddle through. Viewed in this light, there may be very little distinction between your students and ours.

3) I want to comment upon the fact that our faculty members are more managers than teachers. As mentioned, our faculty is made up of roughly equal parts civilian, permanent military and rotating military. Typically upper level courses are taught by civilian and permanent military faculty. However, roughly seventy percent of our general chemistry faculty are rotating military personnel who will spend four years teaching at the Academy, and then go back to their area of specialty within the Coast Guard, likely never to formally teach again. This has both good and bad points. On the good side, since we have a high turnover, we have lots of new ideas coming in without a weighty administrative infrastructure to interfere with things. When one of our new faculty reports in he/she will have had from four to eight years of managerial experience. Consequently, when he/she identifies a problem, he/she is most likely to spend the weekend planning a strategy to fix it, and then implement that strategy the following week. By the time a rotating military faculty member arrives at the Academy, managing problems is part of his/her nature. On the down side, most of us are not "real teachers." By this I mean those special individuals who display both a love for their discipline, as well as for passing it on to successive waves of students. What I am trying to point out is this, as managers we feel we have made progress in improving the way in which our students relate to the discipline of chemistry and we are excited about that. Now I challenge those of you who are "the professionals" to critique, improve and most of all put into play some changes of your own.

MAKING SOME CHANGES

All of the pessimism regarding the future of chemistry tends to overshadow a very important fact - namely that chemistry is an inherently interesting and relevant subject. Chemistry provides the answers to many otherwise inexplicable observations from both our present and past. Therefore there had to be a way to make chemistry interesting. The starting point for reshaping our chemistry program was just that simple; like many others, we had too often reached the point where we were caught up in emphasizing content to the exclusion of student interest.

Since we had the confidence that our subject matter can indeed be interesting, the next question was where to begin to make changes. The first step was the most important. The faculty involved with the general chemistry program at the Academy began a long series of innovations by developing a list of "desired outcomes." It is not that we were operating without goals. The Academic Dean had established a set of goals providing direction for the Academy's Academic Division. They were in effect a set of marching orders from which we were able to make specific application. Therefore, working under the Dean's general guidance we developed the list of "desired outcomes" given below:

> CONTENT: Each cadet who passes General Chemistry will have the minimum necessary foundation, within the discipline of chemistry, to take upper level undergraduate courses in chemistry, toxicology, industrial hygiene or chemical engineering.

DECISION MAKING: Each cadet who successfully completes our course of study will have a grasp of rudimentary chemical principles for the purpose of supporting his/her decision making in a variety of Coast Guard activities as well as the demands of daily living.

ANALYTICAL PROBLEM SOLVING: Students will begin developing competency in problem solving through the following steps:

> Identifying the problem and it's related information

> Following a series of logical steps to a correct solution using the given information

Problem solving will be accomplished via mathematical as well as written solutions.

COMMUNICATIONS: The General Chemistry program shall provide opportunities for all cadets to begin building expertise in technical writing, and the use of computers.

INTEREST: The General Chemistry program will attempt tc quicken the curiosity of our students and foster enjoyment in the sciences.

PROFESSIONALISM: Faculty shall make every effort to teach cadets to approach General Chemistry with the same effort expected of Coast Guard Officers in the performance of their assigned duties.

As you can see there's nothing fancy here. So what did they accomplish? First, they gave us a long range vision for our program, and one in which all faculty had shared ownership. Second, they provided a set of checks and balances against which to measure any future innovations. We have tried hard to make sure that as our program unfolds and develops, all changes are consistent with our long range

goals, which simultaneously keeps them consistent with the Dean's. Third, they give us a base of written documentation to pursue support from the administration and brief new additions to our faculty.

Once the desired outcomes were firmly established we had a multitude of planning sessions devoted to the development of a series of "implementing steps" in order to move toward our desired outcomes. These sessions were basically brainstorming sessions where our faculty drew upon their experience, science education literature, etc. Over the course of a 4 month period our program for the 1991-92 academic year was hammered out. I would like to detail some of the major changes.

The first major change we implemented was a deliberate effort to clearly convey our expectations to our students. This is certainly not a novel idea, and we would of course all recognize its importance. However, I ask you to consider how many of you have students who routinely complain, "I did all of the homework, but the test wasn't anything like it," or "I spent all that time studying and then you went and tested us on something else." We certainly did! Here is what we did to try and address this problem. First, since we are dealing with freshman, most of whom have questionable study habits, we devoted a reasonable amount of time and written documentation to describing an academic routine well suited to the study of chemistry. Next, we divided the semester up into a number of exam cycles each of which corresponded to the material covered for a given exam. At the beginning of an exam cycle each student gets a syllabus (reading , lab & homework assignments) and a list of objectives. The list of objectives clearly spells out exactly what we expect the student to master as the result of our lecture and laboratory program. We clearly specify whether mastery of an objective is quantitative, descriptive or predictive in nature. In short, we are specifying both content and process. This simple

investment in communicating our expectations to our students has paid tremendous dividends. First, each of our teachers now has assistance in organizing the developing of a set of cohesive skills within their students, skills which are based firmly on a knowledge of chemistry. (This is especially pertinent in our case, because although we have five or six different instructors, all of our students take a common exam.) Second, the student response to this experiment has been most gratifying. The objectives have become in effect a yardstick by which students can routinely gauge their progress. It is no longer unusual for a student to come in for extra help with a series of well defined questions on various aspects of the material we have covered. The questions are usually related to the objectives though not always. It is exciting, because at times you can literally see the synthesis process occur, and since we wrote the objectives we feel confident regarding the outcome of the synthesis process. During exam time our students are now quite focused in their studying. Most gratifying of all is their post exam response. I personally queried the entire class after giving what I felt was the "toughest" exam of the last four or five years. Rather than the usual chorus of complaints, there were virtually no comments regarding the unfairness of the exam, existence of trick questions etc. The almost unanimous response could be summed up as, " tough exam, but there wasn't anything on it I didn't expect." As you can imagine this does wonders for student - teacher rapport; we have begun to become partners in striving for a common goal. You may object to this approach on many grounds, our response to this is simple and to the point:

1) We now hold our students accountable to master a much greater level of difficulty than we have in the past.

2) It is considered ideal managerial behavior to accurately communicate expectations to your subordinates (8).

3) Do you question this concept on grounds of principle or because of the work it entails?

The attitude of our students, specifically their attitude towards learning chemistry, was our next focal point. We wanted to create a positive view of chemistry as a discipline, display its relevance to everyday life and illustrate its major role in their future career success as Coast Guard officers. We attempted to convey these points on a wide variety of fronts: It was accomplished in writing in their course information sheet. Our instructors further reinforce them as a matter of course every week throughout the semester using newspaper articles and appropriate Coast Guard reports. We even began the semester by attempting to make a major impact on their attitudes. During the first week of class we cancelled one of the regularly scheduled lecture periods, and instead held a required evening session for the entire freshmen class. The sole purpose of the session was to show our students that between their career aspirations and their present educational status, there existed a significant shortfall in terms of their grasp of the basic chemistry needed to make informed decisions. We did this by choosing two recent occurrences to which all of our students could relate. We chose two Coast Guard cases, one a fire and explosion on board a tanker in the Gulf of Mexico, and the other a major drug bust in the Caribbean. One of our instructors acting as moderator began describing the scenarios using actual slides of the incidents. (Needless to say it is very easy to get the attention of freshman in their first week of college classes in this manner.) As the scenario unfolded, several other faculty members playing the the role of TV reporter/cameraman rushed into the audience. They randomly selected students, and began to ask very rudimentary questions regarding the scenario. The questions had been predesigned to be: 1) reasonable for the person on the street to ask, 2) obviously tied to the discipline of chemistry and, 3) part of the planned

curriculum for the general chemistry course. Within a 25 minute period we had placed all of our students in a dilemma. They all had visions of themselves doing the very things portrayed by officers in the slides, yet not one of them had been able to answer a list of very basic questions pertaining to the incidents. When they filed back to their residence halls they had all had a graphic demonstration of the importance of their academic curriculum to their future. Since that first week, we have made every effort to insure this impact does not die. This opening program is something that is easily brought up during the course of the semester as we cover pertinent material in the classroom. Furthermore, we plan to conclude our course each year by using the same scenarios and list of questions as a means of showing our students (and their teachers) how far they have progressed.

We have also begun to employ a less dramatic method of modifying student attitude which we call "hooks." Be aware this concept is contrary to the normal lecture/textbook approach to learning, i.e. building a concept by putting together a series of small often unconnected tidbits of information. This building block approach, unfortunately, has caused many of our students to lose sight of the forest for the trees. What we are trying to do through the use of our "hooks," is to tap into student curiosity by drawing on their existing knowledge of the big picture, as well as to develop their facility with the scientific method. So what is a hook? Before the introduction of each major topic (four times a semester), we devote roughly half a class period to tearing apart the upcoming topic. We start with the big picture, and try to get the students to question the component parts. For example, before beginning the study of kinetics we discussed in general terms the idea of reaction rates. We related it to our students base of common knowledge such as the spoiling of food, the rate at which things burn, etc. We want our students to realize that they do have a valuable frame of reference, and that we are trying to promote its

further development. Next we try to initiate collaborative learning by asking what type of factors might influence the rate of a reaction. The responses vary class by class, but they all suggest temperature, and many include concentration and catalysts. With a little preplanning, we now have the opportunity to unfold the scientific method. We begin to explore their hypothesis by conducting a series of simple experiments, keeping track of the class's observations. By the end of a half hour series of experiments and observations, our students are capable of developing a thesis containing a reasonable facsimile of the rate law. Thus the "hooking" together of what they know with what they don't know. Consider the value of this process - before our students even crack their text book to undertake a detailed study of kinetics, they have a graphic understanding of the factors that effect the rate of a reaction and have already experimentally derived a rough rate law. This results in increased attention in the classroom, and what's more, both student and instructor now share a ready frame of reference from which both can draw.

Our final means of adjusting student attitude is a straightforward attempt to keep class interesting. We try to bring in as much outside material and as many demonstrations as possible. We have found that their is just no substitute for good demonstrations when it comes to maintaining interest and helping provide a visual representation of theory. This means all of our instructors are on the lookout for new and innovative demonstrations. We have even gone so far as to assign one person the specific responsibility to research and prepare new and pertinent classroom demonstrations.

The next change we have implemented relates to the topic of "number crunching." You better than I, are aware of the intense dislike of many students toward dealing with mathematical equations. In many cases this is true of even those students

attracted to the sciences. Students are not the only ones who complain about the typically numerical approach to general chemistry. I have heard many faculty members (usually organic or biochemists) complain that general chemistry has degenerated to nothing more than baby P. Chem, and is scaring off our best hopes for the future. Regardless of your personal point of view, the fact remains most of our entry level students do not like numerical manipulations. Can we do anything to overcome this obstacle to enjoying the sciences? We have tried to address this problem by carefully reviewing the material we intend to teach, and then whenever possible move a topic from the quantitative realm to the qualitative. We then simply communicate this change to our students through their list of objectives. So what have we accomplished? First, given the heavy numerical orientation of most textbooks, we have succeeded in providing a somewhat more balanced approach to chemistry. Second, there are many cases where a qualitative understanding is just as good as or better than a quantitative grasp. For example, we recently changed our approach to the topic of colligative properties. Rather than have our students demonstrate their proficiency in this area by calculating a change in boiling or freezing point based on the addition of so many grams of solute, we now also accept a qualitative understanding. They will have received sufficient instruction to describe the concept of freezing point depression or boiling point elevation through the use of phase diagrams and an explanation of how a nonvolatile solute effects the vapor pressure of a liquid. In our view, being able to demonstrate a qualitative understanding of these concepts demonstrates a firmer grasp of the chemical principles related to colligative properties than does the reproduction of a series of numerical calculations. In addition, you would certainly have to admit that a qualitative understanding is satisfactory for any student who is a future automobile owner, Coast Guard Officer or student entering an upper level P. Chem course. By the way, when we give our students the opportunity to qualitatively demonstrate

their understanding of chemistry, it is understood by our students that we require grammatically correct and well organized explanations.

What of our lab program? We certainly were not going to overhaul our lecture course without tackling the lab program as well. Modification of the lab program was again very straightforward. We diligently tried to make sure that our lab program was designed solely to support the lecture program. Too often in the past our lab program was slightly out of sequence with classroom material, or overloaded our students with too much new material. The result was a great deal of frustration on the part of our students, and the common complaint, " I hate lab because it doesn't seem to have anything to do with the course." Now we preach and act out a much more consistent message to our students, namely, "the purpose of the laboratory program is so that you can see right in front of your own two eyes what we have been discussing in the classroom." One very obvious measure of our success is that our students have stopped asking if the material covered in lab will be on the exams. The lab and lecture material are homogeneous to them, and they don't see any distinction between course and laboratory objectives.

We have also tried to modify the normal lab routine, i.e. collect data, complete report sheet, and answer post-lab questions. We have tried to stimulate the learning process and begin the development of technical writing skills by designating three or four labs per semester as "group labs." For our purposes, "group labs" begin after data collection. The students, working in groups of four or five of their own choosing, are required to submit a formal lab write-up following data collection. The formal write-up consists of: a detailed purpose, theory, procedure, calculations, conclusion and question section. We choose the most difficult labs as "group labs" to take advantage of the synergism that can occur within a group (9). The lab report

is graded on technical writing merit as well as content. (I must admit we start out correcting only gross problems in their writing styles, as the technical writing abilities of even our strong students is abysmal. For this reason, we feel any progress is a step in the right direction. Our future plans call for enlisting the aid of both the English department and the Writing Center.) We have experienced moderate success to date; however, our biggest obstacle continues to be ensuring sufficient "group work" actually occurs. The literature documents the importance of this (9), yet our students have extremely busy schedules outside of lab.

The last innovation in our lab program is something we call a "discovery lab." It is basically the laboratory counterpart of the classroom "hook." Once or twice a semester we set aside the "normal" lab, and instead attempt to have our students generate the lab from a real world problem. We start out with a discussion of the most recent classroom material, and its relevance to the real world. We then assign them a "real world" problem and let them work at it. To give you an example, our discovery lab during the 2nd semester follows the topic of electrochemistry. At the end of the introductory discussion they are given the following scenario:

> You are on board a Coast Guard helicopter making a logistics run along the Aleution chain. During the flight the helicopter develops mechanical problems and is forced to crash land on a small deserted island. After landing you discover that the emergency radio beacon contains corroded batteries and will not function. The beacon requires a twelve volt power supply to function properly. You have on board the helicopter the attached list of items. Your mission is to use the material at your disposal to aid in your rescue. You have, due to extreme weather conditions, 3 hours before your extremities loose fine motor control. Good luck. Note: your grade for this lab will be based on how thoroughly you document any hypothesis and subsequent experimental verification. (The students have among other things, sufficient

materials to build electrochemical cells capable of powering the radio beacon. Experimentation is typically done in pairs in order to promote collaborative learning, while the lab write-up is treated as a group lab.)

The students seem to really enjoy the much less rigid atmosphere of this type of lab, as they wrestle with the problems and try out their own solutions. Yet we feel they still meet reasonable academic goals as they document and justify their experimental work.

You now have a rough sketch of the model we have implemented at the Coast Guard Academy. In addition to the major changes mentioned above, we have made many more modest modifications. Some of the more noteworthy are listed below.

Outlining/Notetaking Skills: We make a purposed effort to teach outlining skills as well as the ability to organize technical information. During most of the course this is demonstrated and promoted by the instructor. However, as part of the second semester program a portion of the students grade rests on his ability to outline, organize and develop suitable example problems apart from any instructor assistance. During this time period the classroom sessions switch from a lecture format to a session driven solely by student questions. Our intent with this innovation is to show the students they can learn the material on their own, and begin to prepare them for the many more academically demanding courses which lie ahead.

Extra Help Sessions: We have no TA's and our faculty provide office hours far in excess of most institutions. To ease both teacher load and provide a routine for our students, we hold twice weekly homework sessions at the end of the class

day. We also hold Sunday night sessions designed to review all of the objectives covered during the preceding week. Thus we are try to stress the importance of remaining current with both homework and course content. Ideally we would like our students to evaluate their standing on a weekly basis and then seek extra help as need be.

Classroom Assessment: We are tying to increase the amount of student feedback we receive during the course of each semester. We are interested in what is confusing our students, as well as their attitudes toward learning. We have tried to implement some of the excellent information described in (10), in order to "measure" these variables. We have received reasonable feedback while expending very little class time.

OUR SUCCESS TO DATE

Our fledgling program has been in effect for just one short year, so it certainly has not withstood the test of time. However, our initial evaluations appear to imply positive returns. We think you will see why we plan to continue investing the time and energy necessary to improve and refine our approach. Consider the following three broad areas of evaluation.

1. Student Performance: If you recall, several of our outcomes were purely academic in nature, i.e. preparation for upper level courses, development of analytical problem solving ability, etc. These are the types of activities that are typically measured by testing. We have not yet compiled any statistical analysis of our students performance, instead all we have is the unanimous opinion of the permanent faculty and all six general chemistry teachers - general chemistry exams given over the course of the last year were much more challenging and of a higher

level of difficulty than anything given in the recent past. When draft copies where given to senior faculty members they consistently responded that the exams were too difficult and too long. The exams also routinely incorporated open ended problems with multiple correct solutions. In truth, the exams were never too long and the averages on these exams where as high or in some cases higher than much less challenging exams given in the past. (Note: this year's class had very similar entering credentials to all of the past several freshman classes.)

2. Student Attitude: Our primary means of assessing student attitude is through the use of course critiques given at the end of each semester in both the lecture and lab program. We also use short assessments given during the course of the semester. Student responses were markedly better than they have been in previous years, and not just for new faculty but for teachers that have been collecting course critiques for 20 years. Student critiques are filled with such comments as, "I really became interested in chemistry once I saw its applicability," "I see the importance of chemistry to my future career," " I really began to enjoy the material once we got started." To conclude our comments on student attitude and performance, I might ask a rhetorical question. Do you think attitude and performance have any bearing on student retention?

3. Teacher Attitude: The effect on student performance and attitude seems impressive, but you might ask what effect has all of this had on your faculty, as it certainly means more work for them? We would have to say that the effect on faculty has been the most pleasant and unexpected result of our program. First of all, there have not been any complaints regarding the increased work load. Instead, there has been a spirit of cooperation and excitement that has not been around for some time. In some cases it is as if the faculty have a new lease on teaching. What's

behind this? As mentioned before, we believe student response fuels teacher job satisfaction. It is awful easy for a teacher to get into a rut, using the same notes and illustrations year after year. Students pick up on the fact that a professor is marking time, and they respond with a matching attitude. When the teacher has a sense of enthusiasm and involvement with his discipline, the students pick up on this as well.

FUTURE WORK

Although we are both pleased and excited about the changes we have made we by no means feel our program has reached its potential. We have quite a few modifications planned for the upcoming year. A few of them are listed below for your consideration.

1. Interconnect Lab with Freshman composition: all of our students begin their freshman year with a course in English composition. We are actively working with the English Department to connect our lab course with their composition course. In this way the formal lab write-ups can be correctly handled as a writing exercise. The 92-93 academic year will see this attempted on a trial basis by having a complete laboratory section also comprise a composition section.

2. Problem Based Learning: there has been a wealth of discussion regarding the merits of problem based learning (11). In fact, ACS has modeled the development of their college level text book upon this approach. We plan to take one topic each semester and cover it using this approach. For example, we tentatively plan to cover introductory material on acids and bases by using a real Coast Guard incident involving a barge loaded with acid. Academic material would then be presented in the context of what does a Coast Guard officer need to know in

order to fully address the situation: protect his own people, protect the public, minimize the impact on the environment, etc. We will essentially have to write our own text to cover these areas, but again we think it will be worth it in terms of both student interest and faculty job satisfaction.

3. Student Assessment: we want to improve our ability to routinely determine what is causing confusion among our students. As mentioned previously there is a good deal of information regarding assessment techniques. We simply want to formalize it as part of our course.

4. Academy Services: the Chemistry Section is not the only group at the Academy attempting to make strides in the quality of education. The blinders need to be taken off, and wherever possible the chemistry section needs to integrate with other emerging programs. For example, the recently implemented Cadet Reading and Writing Center and study skills workshops can certainly enhance our program. Perhaps these connections will be the first steps toward our long term goal of making interdisciplinary ties between our general chemistry course and the remaining freshman curriculum effective.

We plan, in summation, to continue to tweak and enhance our course per available resources. To remain vital we must continue to arouse the interest of our students, and work hard to insure they have a firm and lasting grasp of the fundamentals of chemistry.

THE POINT

We would like to close by bringing several points to your attention. First, We simply throw down the gauntlet. We challenge you to overcome your institutional

inertia and start making some advances in the classroom. If our small attempt at managing the business of teaching can be of any use, make the most of it and improve it in the process.

Second, what is the cost, in terms of resources, to implement the type of approach modelled above? In terms of capital equipment - nothing. In terms of commitment - it takes time and effort, especially in the early implementation stages. These are resources that are available to every institution. Is it worth it? Ultimately you will have to answer that question for your own institution, but please face up to what is at stake. We have the potential to attract, interest and greatly influence our students; this in turn will shape the future of our nation. Is this not job satisfaction? Is this not what drew many of you to teaching as a profession? Continue as you began, and you will see the results of your efforts. On the other hand, a continued exodus of students from the sciences will result in a failure to live up to our technological heritage. Think it through and realize that one way or another, your actions will indicate your choice.

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